NCDWQ Technical Assistance Report

Appendix K

NCDENR
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July 6, 2010

Mr. Barry Jones
Cliffside Sanitary District
P.O. Box 122
Cliffside, N.C. 28024

Subject: Technical Assistance
Cliffside Sanitary District WWTP
NPDES Permit No. NC0004405
Rutherford County

Dear Mr. Jones:

Mr. Don Price, and other staff with the Asheville Regional Office of the NC Division of Water Quality (DWQ or the Division) conducted a technical assistance visit of the Cliffside Sanitary District wastewater treatment plant (WWTP) on May 20, 2010. The assistance and cooperation of Mr. Mike Gibert, WWTP ORC, was greatly appreciated. The purpose of this Technical Assistance was to review the operation of the WWTP and to help identify repairs and to offer suggested retrofits needed to meet existing, and to meet future permit limitations. It was also the intent of the Technical Assistance visit to find ways to reduce energy and chemical costs through more efficient operating techniques. By enhancing plant operations, we help improve water quality. A checklist is attached for your records and findings are summarized below.

Site/System Review

The following system components were reviewed during the visit: The current WWTP consists of a pump station and bar screen; extended aeration basin; dual secondary clarifiers; Aqua disk filters; chlorination; effluent re-aeration; and de-chlorination; and sludge storage tanks.

This current arrangement is being operated as a 'Partial mix' aerated lagoon. Samples were collected from the Influent and Effluent, in addition to conducting a dissolve oxygen (DO) profile of the lagoon unit (extended aeration basin).

The following table(s) summarize the findings derived from conducting the DO profile, and results from the samples collected at the WWTP. Table 1 identifies DO, pH, and Temp. findings from grab samples collected at the time of the site visit; Table 2 identifies results of composite samples collected for BOD, TSS, Alkalinity, and Fecal Coliform(grab sample).

Table 1.

Location	Dissolved Oxygen (mg/L)	Temperature Degrees C°	pH (s.u.)	Alkalinity (Test Strips)	Ammonia (Test Strips)
A-B Entry point 1	0.72	24.1	7.48	180 mg/L	> 6 mg/L
A-B Entry point 2	0.60	23.7	—	—	—
A-B Entry point 3	0.81	23.8	—	—	—
A-B mid-point south	0.30	22.3	—	—	—
A-B south right corner	0.55	23.8	—	—	—
A-B south effluent	0.68	23.8	7.37	180 mg/L	1 mg/L
A-B North effluent no flow	0.22	22.6	—	—	—
A-B North mid access point	0.76	22.0	—	—	—

As mentioned earlier, the current WWTP is being operated as a Partial mix lagoon. This type of WWTP can commonly be used to treat municipal and industrial wastewater(s). Partial mix lagoon technology has been widely used in the United States for at least 40 years or more. Aeration is provided by either mechanical surface aerators or submerged diffused aeration systems (*current aeration at the time of the technical assistance was provided by two (2) floating mechanical aerators*). The submerged systems can include perforated tubing or piping, with a variety of diffusers attached. In aerated lagoons, oxygen is supplied mainly through mechanical or diffused aeration rather than by algal photosynthesis.

Aerated lagoons typically are classified by the amount of mixing provided. A partial mix system provides only enough aeration to satisfy the oxygen requirements of the system and does not provide energy to keep all total suspended solids (TSS) in suspension. In some cases, the initial cell in a system might be a complete mix unit followed by partial mix and settling cells. Most energy in complete mix systems is used in the mixing function which requires about 10 times the amount of energy needed for an equally-sized partial mix system to treat municipal wastes. Table 1 indicates dissolved oxygen levels in the Lagoon of between 0.22 mg/L and 0.81 mg/L. For the system to produce an effluent to meet concentration based limits (milligrams/liter), rather than the current mass balance limitations (pounds/day), a dissolved oxygen concentration of at least 2.0 mg/L will have to be maintained throughout the Lagoon system.

A complete mix wastewater treatment system is similar to the activated sludge treatment process except that it does not include recycling of cellular material, resulting in lower mixed liquor suspended solids concentrations, which requires a longer hydraulic detention time than activated sludge treatment. Some solids in partial mix lagoons are kept in suspension to contribute to overall treatment. This allows for anaerobic fermentation of the settled solids.

Partial mix lagoons are also considered facultative aerated lagoons and are generally designed with **at least three cells in series**, with total detention time dependent on water temperature (*the current system consisted of only one (1) cell followed by allowing flow through one secondary clarifier*). The lagoons are constructed to have a water depth of up to 20 ft to ensure maximum oxygen transfer efficiency when using diffused aeration (*current depth is 16 feet*). In most cases, aeration is not applied uniformly over the entire system.

Typically, the most intense aeration (up to 50 percent of the total required) is used in the first cell. The final cell may have little or no aeration to allow settling to occur. In some cases, a small separate settling pond is provided after the final cell. Diffused aeration equipment typically provides about 6 to 6.5 lbs O_2/hp-hour and mechanical surface aerators are rated at 2.5 to 3.5 lbs O_2/hp-hour.

Consequently, diffused systems are somewhat more efficient, but also require a significantly greater installation and maintenance effort. Aerated lagoons can reliably produce an effluent with both biological oxygen demand (BOD) and TSS < 30 mg/L if provisions for settling are included at the end of the system. Significant nitrification will occur during the summer months if adequate dissolved oxygen is applied. Many systems designed only for BOD removal fail to meet discharge standards during the summer because of a shortage of dissolved oxygen. Nitrification of ammonia and BOD removal occur simultaneously and systems can become oxygen limited, of which the system at Cliffside Sanitary District appears to be.

To achieve nitrification in heavily loaded systems, pond volume and aeration capacity beyond that provided for BOD removal are necessary. Oxygen requirements for nitrification are more demanding than for BOD removal. It is generally assumed that 2.5 lbs. of oxygen is required to treat 2.2 lbs. of BOD. About 8 lbs. of O_2 are theoretically required to convert 2.2 lbs. of ammonia to nitrate.

A physical modification to an aerated lagoon uses plastic curtains supported by floats and anchored to the bottom to divide existing lagoons into multiple cells and/or serve as baffles to improve hydraulic conditions. One approach suspends a row of submerged diffusers from flexible floating booms which move in a cyclic pattern during aeration activity. This serves to treat a larger volume with each aeration line. Effluent is periodically recycled within the system to improve performance. If there is sufficient depth for effective oxygen transfer, aeration is used to upgrade existing facultative ponds and is sometimes used on a seasonal basis during periods of peak wastewater discharge to the lagoon (e.g. seasonal food processing wastes). *Every system should have at least three cells in series.*

Pond depths range from 6 to 20 ft, with 10 ft the most typical (the shallow depth systems usually are converted facultative lagoons). Detention times range from 10 to 30 days, with 20 days the most typical (shorter detention times use higher intensity aeration). The design of aerated lagoons for BOD removal is based on first-order kinetics and the complete mix hydraulics model. Even though the system is not completely mixed, a conservative design will result.

Table 2.

Location	BOD (mg/L)	TSS (mg/L)	pH (s.u.)	Alkalinity (mg/L)	Fecal Coliform (#/100 ml)
A-B Entry point 1	118	240	7.3	310 mg/L	—
A-B south effluent	161	208	7.3	330 mg/L	—
System Influent Composite	71	18	7.0	110 mg/L	—
System Effluent Composite	109	104	7.4	280 mg/	—
System Effluent (Grab)	115	102	7.5	290 mg/L	520

Results of samples collected in Table 2 indicate the current treatment system **would not** meet concentration based limitations.

Based upon information regarding the current system's configuration and capacities the following loading determinations have been made.

The current 'aeration basin' has a square footage of 64,375 $ft.^2$; cubic footage of 1,030,000 $ft.^3$; and a volume of 7,704,400 gallons. This volume would allow for a theoretical detention time of 30.8 days at a flow of 0.250MGD (250,000 gpd), or 25.68 days at a flow of 0.300 MGD (300,000 gpd). Most partial-mix aerated lagoons operate at an Organic Loading of 15 – 30 lbs. BOD/acre/day, but with efficient aeration and detention time (without short-circuiting) can increase loading from 60 to 200 lbs. BOD/acre/day. Based upon data in Table 2, The BOD load to the current system equals 29.6 lbs. BOD (*0.050 x 71 mg/L x 8.34*) per day. The current system has a equivalent acreage of 1.47 acres based upon the square footage of 64,375 ft^2. This is equivalent to 100.6 lbs. BOD/acre/day, falling between the 60 to 200 lbs. BOD/acre/day loading "*IF*" efficient aeration and no short-circuiting exists in the system.

The current system revealed signs of short-circuiting and organic overload due to indications that "septage" is being added at entry point 1 of the aeration basin. Any septage added to the system should be 'pre-treated' prior to being added to the system. Pre-treatment should consist of at a minimum of screening and pre-aeration. This would help in preventing 'shock-load' effects to the treatment system. Shock loading of the system is evident in effluent BOD and TSS results (A-B south effluent BOD 161 mg/L, TSS 240 mg/L).

Suggestions/Recommendations

The current system would not be capable of meeting concentration based limits as should be reflected in the next NPDES permitting cycle for this system (**current NPDES permit is set to expire in July 2013**). In order to meeting concentration based limits it is suggested the system look at:
(1) A physical modification to the existing aerated lagoon using some type of curtain or other means of separation to divide the existing lagoon into multiple cells and/or serve as baffles to improve on current hydraulic conditions and prevent short circuiting;

(2) Add a type of "*Induced Air Flotation*" in the initial tank prior to the lagoon, in order to add septage to the system and not create nuisance and organic loading issues. This would act as a 'septage receiving station' allowing some removal of fats and grease, solids, and other debris before it reached the lagoon system. Such systems have been added as 'pretreatment' for Dairy waste in Minnesota, in a 10' by 6' tank, with a depth of 6'. Information provided implied it removed from 20 to 30% of the total BOD load to the treatment plant using only a 2 HP motor.

(3) Review options of adding curtain baffles to the existing contact basin. This would prevent short circuiting and increase detention time in the system. The entire aeration system needs to be evaluated and changed to a more efficient aeration system. This could be either some type of diffused system or a different type of aerator that uses less energy/power.

I am attaching several documents regarding 'Lagoon Aeration' and cost savings from modifications implemented for your review. I can make additional visits to the facility to conduct evaluations of any modification implemented and offer suggestions for improving operation. In addition to the suggestions listed, I would also suggest you review converting the existing Secondary Clarifiers into SBR's (Sequencing Batch Reactors) or circular package type WWTP's, but please note that these types of systems would use more energy than Lagoon technology.

Also, if there are questions or additional information is needed regarding a process change or permit question, please let me know. Thank you for the opportunity to conduct this Technical Assistance.

Sincerely,

Donald R. Price

Donald R. Price, CET
Waste Water Treatment Plant Consultant
Asheville Regional Office
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Attachments:

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